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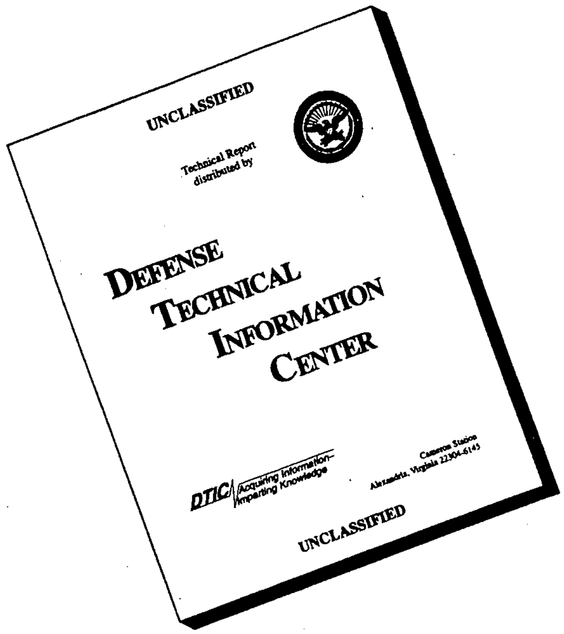

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HUMAN TRANSLATION

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INDIA - EMERGING SPACE POWER

BY: Cai Hongkuei and Shu Leiming

On July 18., 1980, on the island of Silihaliketa (phonetic) off the east coast of India a 36 kilometer man-made earth satellite was launched into space. This successful launch made India the sixth nation capable of launching satellites following the Soviet Union, the United States, France, Japan, and Japan. More than ten years later, in April of 1992, a Chinese delegation of nine space technology experts arrived at the capital of this old and mysterious country for a two week all-encompassing survey of the current status of this nation's carrier rockets, scientific satellites, launch facilities, monitoring and control capabilities, space materials and element and component production as well as plans for development. All of the experts were impressed by the India's rapid development in space technology.

On the aforementioned Island of Silihaliketa (phonetic) there were two launchers, one 40 meters and one 76 meters. A third launcher to be used for launching synchronous stationary communications satellites was under construction. This is the major launch site for India's space research organizations, used to launch satellite carrier and space exploration rockets. India's space research organization's range facilities headquarters and largest solid fuel space booster factory are also here. There are also static testing and evaluation facilities here as well as computer processing facilities in order to ensure the carrier research and development and launch missions are completed.

Another missile launch site, the Dunba (phonetic) Equatorial Rocket Launch Station is located near the southernmost city of

India, Trivandrum. This station went into operation on November 21, 1963. It was on this day that Dunba (phonetic) launched its first rocket, creating the first page of India's space history. To commemorate the founder of India's space planning, Doctor Weikelanlamushalabai (phonetic), in 1972 the name of the Dunba center was changed to the Weikelanlamushalabai Space Center. In addition to the launch site, this center also has a space science center, a rocket propellant factory, a rocket assembly facility and a rocket fuel factory.

Fig. 1. Liquid fuel rocket testing platform near the equator

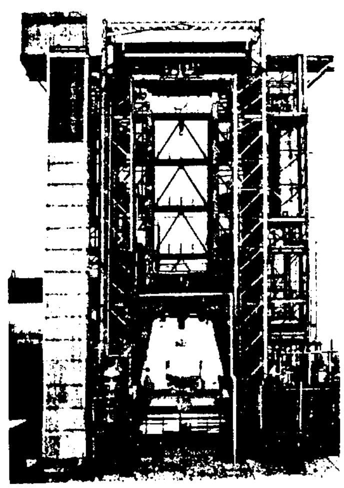


Fig. 2. 76 meter tall sealed launcher

The Weikelanlamushalabai Space Center is the largest of India's space research organizations, with more than 5000 workers, primarily responsible for research and development of space survey rockets, satellite carrier rockets and some technologies related to space shuttles. It is located near the equator and can be used for research into magnetic field effects and atmospheric properties. It can launch high altitude probe rockets 80 to 350 kilometers into space. It can conduct biological research and research into the stratosphere and ionosphere. Because the area is highly populated, large carrier rockets and satellite launch operations are all concentrated 600 kilometers away on the rocket launch site on the east coast of Madelasi (phonetic).

The Indian space research organization has established a fairly complete research, production, testing and monitoring and control bases, evenly distributed in 18 areas throughout the country. The headquarters of the space monitoring and control network is located in the fifth largest city of Bangalore. Its

ground monitoring and control network provides services to carrier vehicles and satellite launch missions. The unified monitoring and control systems of the multiple function overall monitoring and control network are situated on the island of Silihaliketa (phonetic), Telifandelang (phonetic), Bangalore, Lekenao (phonetic) and the monitoring and control station on the island of Kaernekeba as well as the multiple purpose space vehicle control center at Bangalore. In order to ensure the reception of signals sent by remote sensing satellites, India also has set up a monitoring and control station at Maoliqiusi (phonetic).

The equipment and operations of the Indian space monitoring and control network includes the PCMC radar, network operations, flight vehicle control, advance planning and analysis, network expansion, communications and other engineering services projects. What is especially worthy of mention is that the C wave precision coherent monopulse radar PCMC which the Indians have developed on their own. It is high precision tracking radar which is used at the launch site and landing zones. It has an operational range of up to 3200 kilometers. It can provide live time data on range, angle and velocity changes. It sends this data to the launch site computer. Its primary purpose is to ensure launch site safety, and to provide live data on the carrier rocket and satellite function analysis.

At Hasang (phonetic) 50 kilometers west of Bangalore is the Indian synchronous fixed communications satellite control center. It is responsible for launching and for in-space control of India's remote sensing satellite. This center has a full set of automatic and limited motion antennas and orbital measurement and testing, auxiliary power equipment and computer equipment. It has an excellent operations building and auxiliary equipment. The primary control station of the Hasang (phonetic) station has excellent

capabilities. It has attained 100 percent reliability in the control of satellites launched by India.

There is another fairly small data processing and command center in Bangalore. It is unique in its display and image processing. It is possible to display at the same time on a single screen the movement of four satellites. It is possible to overlay text or dynamic graphing and numbers over the basic image, as well as split screen and enlargement. The overall system is networked with DECnet. It has 55 screens from which the command personnel may select.

India began research and development on satellites in the seventies. It has developed six satellites so far. The first type of satellite was the Aliyahata (phonetic) satellite. It was launched by the former Soviet Union. It was primarily used for X-ray astronomy, solar physics and high atmospheric physics experiments. The second type was the Basikala (phonetic) satellite, two of which have been launched. This satellite is an earth survey satellite, equipped with a television camera, infrared camera and a dual frequency microwave radiometer. The third type is the Aipuer (phonetic) satellite. This is the first three axis stabilized stationary communications satellite developed by India. Its C band is used for communications experiments. The fourth type is the Luoxini (phonetic) satellite series. These are primarily used to demonstrate the capabilities of the SLV rocket and the ground monitoring and control system. The fifth type is the broadcast television satellite and the India satellite series. The sixth type is the India remote sensing satellite series. This series satellite has already had some successes in resource detection within india.

India has launched 16 of these different satellites, including

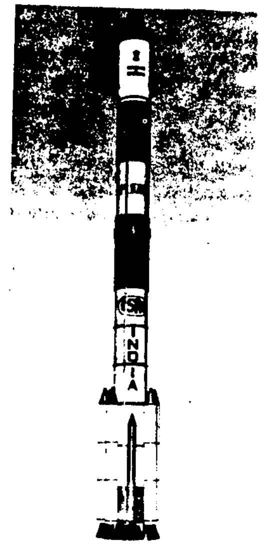
five which used its own carrier rocket, of which two were successful. It launched 11 using foreign rockets or space shuttles, of which 9 were successfully deployed. India's carrier rocket technology still requires further improvement.

India's space research organizations made a decision in its the early days to develop and produce its own space exploration rockets. Several years later, India developed the Luoxini (phonetic) series space exploration rocket. The first was a two stage rocket which could launch a 10 plus kilogram payload to an altitude of 80 kilometers. It was suited for weather and upper atmospheric research. The second type was a single stage rocket. It was capable of launching a 50 kilogram payload to an altitude of over 100 kilometers. The third type was the largest in this series, and was also a two stage rocket. It was capable of launching a 100 kilogram payload to an altitude of over 350 kilometers. There, it is very much suited for tests in the ionosphere.

In order to complete the task of launching its own scientific satellites, India has imported rocket production technology from France to produce four models of carrier rockets. These four types are the SLV-1 rocket which can carrier a 35 kilogram satellite into low orb it, the ASLV rocket which can carry a 150 kilogram satellite into low orbit, the PSLV which can carry a 1000 kilogram solar synchronous resource satellite into polar orbit, and the GSLV which can carry a 2500 kilogram broadcast television satellite into synchronous orbit. Five launch tests have been conducted of the first three types of carrier rockets, with two launches of the SLV-1. The launch times of the PSLV and GSLV were set for 1993 and 1995.

Fig. 3. ASLV launch

Fig. 4. PSLV rocket



In addition to having fairly strong research and development capabilities for liquid fuel rockets with fairly strong thrust, India also has the advanced technology and production processes for solid fuel rocket research and development. It has a complete set of raw material processing bases and research and development facilities. In the late eighties, India completed development of an intermediate range missile with a range of 2500 kilometers. This missile has an effective payload of 2.5 tons. It weights 14.2 tons and is 19 meters long. It has a fairly high accuracy against its target.

According to England ("Janes Defense Weekly", January 23, 1993), India had already begun development of a new cruise missile. India was carrying out its Ajiani (phonetic plan), which demonstrated that it had the capability of developing intermediate and long range guided missiles. There are currently 34 nations in the world which possess short range and intermediate range missiles, with ranges from 70 to 4.750 kilometers. There are 22 nations which have the capability of developing and exporting new

missiles or of improving their existing missiles. India is one of these nations.

Although India denies that it has a nuclear weapons plan, it is commonly accepted in international circles that it possesses sufficient materials to process a nuclear bomb, and that it has the technology to make such a weapon. India currently possesses enough nuclear material to manufacture about 60 nuclear bombs. As Its space technology continues to develop and its carrier rocket capabilities continue to improve, when added to its well known strong conventional forces, especially its rapidly expanding air forces, India's defense modernization has undoubtedly reached a new stage.

The development of space enterprises in India can be tracked back to the early sixties. In 1962 India established a Space Research Commission, and in 1968 and 1972 the established the Space Research Organization and Space Ministry respectively. In 1963 it developed the first space activity, the launch of a space exploration rocket. In the 30 years since, the ranks of technical personnel conducting space science research and engineering testing throughout India have grown to more than 16,000. This does not include service personnel. India has also established six centers, two rocket launch and satellite launch sites, organized a satellite monitoring and control network for its own satellite launching and signals processing. It has conducted a total of more than 3,000 space experiments.

The reason India's space technology has been able to grow so rapidly is directly related to its national situation the emphasis of its leaders. India has the second largest population in the world (already approaching 900 million), and it ranks seventh in the world in area. In order to accelerate the improvement of its

social and economic conditions, India pays a great deal of attention to developing technology and industry, and the exploration and development of space technology is the focus of India's science and technology. With its large population, high rate of illiteracy, many natural disasters and backward state of resource development, the development of satellite communications and television educational plans, satellite resource surveys and management as well as satellite assisted meteorological technology will become the focus of India's space technology construction.

In order to improve its technological management and guidance over all the centers around the country, all of India's space activities take place under a unified plan. The activities of the Ministry of Space mainly includes the design and development of rockets and satellites, data processing and management of resource satellites, propellant production and civil engineering design. In order to improve leadership over space technology, the Premier is himself responsible for the Ministry of Space. This shows just how important India's space technology and science is.

Another reason for India placing such emphasis on space technology is because it determines its position as a major political and economic player in Asia. Therefore, India has invested a great deal of money and of its technological resources, investing about 200 million Dollars in space engineering every year. The various centers have had almost no financial difficulties in completing the missions assigned by the Ministry of Space.

EUROPE'S SPACE ACTIVITIES IN THE NEXT TEN YEARS

BY: He Wen

In the next five years, Europe's space plans will continue to improve and expand into military, science and manned flight. There will also continue to be more cooperation with Russia.

Most of the European space plans will have fairly stable finances for the near future. The next five years will be the most active in the history of European space research. These space activities will include: Testing of all components of the Arian-5 carrier rocket, and its launching in 1995; the development of several new military satellites; the development and testing of the Colombo capsule and a polar orbiting station.

However, Europe's space activities will also be limited by the poor economic prospects world-wide. In the next eight years, the European Space Administration (EPA) will have expenses of 26 billion U.S. Dollars, four Billion less than originally planned. The Mercury space shuttle plans are also awaiting cancellation. The already tight budget for the Colombo capsule plans will be reduced by four to five percent. The European space activities are directly related to the Colombo plans, and those plans are limited by the redesign of the American Freedom space station.

In 1993 the French civilian space budget increased by seven percent, and the French space budget will double by the mid-nineties. The French National Space Research Center (CNES) uses 1.5 billion Dollars of the civilian space plan funding. In the next five years, CNES will play a leading role in European military activities, and the French have decided to turn over military space

research management operations to CNES. This will make CNES even more important. The French will continue to cooperate with Russia in Space research and manned flight. At the same time, they will also increase cooperation with the Americans in solving environmental problems.

England has been spending less than 300 million Dollars on its space plan. Recently it too increased research and management at its space facilities. The British National Space Center (BNSC) will be responsible for research operations and commercial activities of space facilities.

The British Space Flight Corporation will be responsible at the end of the year for the research operations for Europe's first polar orbiting platform, the Envisat-1, with will require 1.36 billion Dollars. The Envisat-1 is to be launched in 1998. This corporation may also play a major role in the second ESA polar orbiting platform. The German Space Administration may also make major contributions to this plan. This platform is programmed to be launched in the year 2000.

The English government will provide 1.5 million Dollars for the British National Remote Sensing Center to use to construct a British commercial remote sensing industry.

There are also a number of problems with the space activities of the Germans and Italians.

The Germans spend one billion Dollars every year on their space plans, but these plans are all affected by the downturn of the economy. The Germans have already taken back their funding for the ESA Mercury plan and have reduced their funding of the Colombo Capsule plan.

The German developed Youlika (phonetic) satellite will not be flown any more in the near future because of high expenses. This satellite, which was deployed by the United States space shuttle in July of 1992, operates well in space. It will be recovered in the near future. The decision of whether or not to cancel the Youlika (phonetic) program will not be made until the satellite is recovered and scientific tests of its materials and other technical operations are evaluated.

The funding for the Italian Space Administration is 640 million Dollars a year. However, the Italian government is conducting an investigation into mismanagement of this administration. This includes funding for the Scout-2 carrier vehicle in cooperation with the United States.

The major problems for the European space plans for the next five years are:

1. Manned space flight. One of the greatest problem facing the European space planners is how to conduct the readjusted manned space flight research. The funding has continued to grow, and the mission continued to be reduced. This has put the brakes on the Mercury plan. However, the European space management personnel continue to hope that Europe will have its own manned space vehicle in the 21st century.

With the Russians, ESA is drafting a new manned space flight plan to replace the Mercury plan. Its goal is to use the Mercury technology as a foundation and use Russian space technology and experience to develop through international cooperation a winged (such as the space shuttle) or wingless (such as the improved Alud) manned space vehicle. ESA is making preparations to make a decision on this in 1995. The French are also want to be the ones

responsible for this research.

2. The Colombo capsule research. The redesigning of NASA's Freedom Space Station has put into question the 2..8 billion Dollar Colombo capsule plan.

Most of ESA space plans for the nineties are centered around the Colombo plan. Germany, Italy and France represent the major part of this plan. Any major changes to this plan will put the German and Italian space plans in a bind.

In March, ESA signed an agreement for research of the Colombo capsule with its international cooperators, and this will increase the attention the Colombo plan receives in the U.S. Congress.

3. The operating expenses for the Colombo capsule. If the Freedom Space Station plan is retained, ESA will negotiate the operating expenses for the Colombo capsule with NASA. ESA estimates the annual operating expenses at 350 million Dollars. ESA plans to pay most of the expenses through the exchange of goods. For example, ESA is prepared to allow NASA to use its one Billion Dollar new data relay satellite system (DRS). That system is planned to go into use in 1999.

4. Scientific experiments. ESA is preparing to make decisions on two scientific experiment activities. This will involve international cooperation between Europe and the United States and Europe and Russia. ESA will shortly decide on its next scientific experiment plans. It is considering an international gamma ray astrophysics laboratory; the construction of a Prisma Stellar Observatory and the Marsnet composed of three to four small landing vehicles. In the late nineties it will select one of these 400 to 500 Dollar research projects to be launched into space.

At the end of the year, ESA must make a decision on the third item of the original four item basic scientific research plan. There are two 700 to 800 million Dollar plans which are still being considered. One is the Rosetta sampling mission and the other is the long infrared sub-centimeter space telescope.

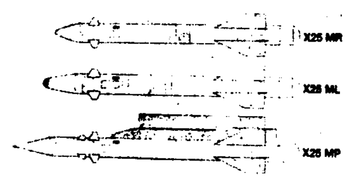
SOME RUSSIAN MISSILES NEWLY MADE PUBLIC

BY: He Ying

In the February 1993 Weapons Fair held at Abu Dhabi, Russia exhibited a number of missile systems including a number of some which had not been made public before.

The X25 and X29 missiles

Fig. 1. Three models of the X25 missile

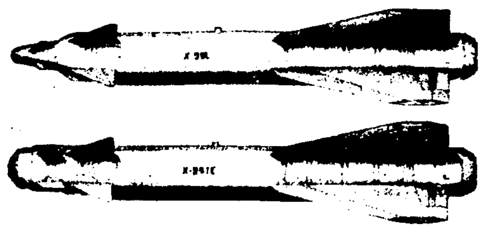


The X25 is a type of modular air-to-surface missile. It includes three models - the semi-active laser guided model (ML), the radio command guided model (MR) and the passive radar guided model (MP).

All three models are 0.275 meters in diameter. The MR is 3.83 meters in length, the ML is 4.225 meters long and the MP is 4.353 meters long. The MR and Ml models weigh 300 kilograms and the MP weights 320 kilograms. the ML and the MP have a 90 kilogram payload and the MR has a 140 kilogram payload. According to official information, the X25MR missile has a range of 10 kilometers, the X25ML has a range of 10 to 20 kilometers and the X25MP has a range of 40 kilometers. The X25MP was designed to handle the United States Huoke (phonetic) surface-to-air missile

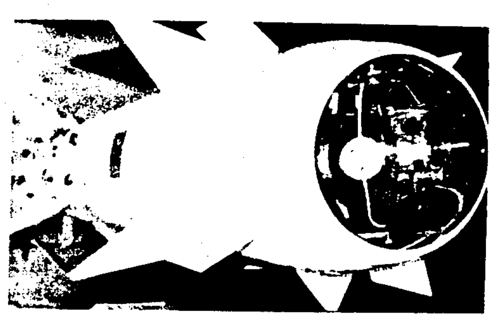
radar.

Fig.2. The X29L and X29TE missiles



The NATO designation for the X29 missile is the AS-14. It is similar the United States Youxu (phonetic - Calf?) air-to-surface missile. It is used on the SU-22M/4, the SU-24 and the Mig-27 aircraft. The X29 missiles include the X29L and the X29TE models. The X29L uses semi-active laser guidance, and the X29TE uses passive television guidance. It is claimed that the X29 is primarily used to destroy solid targets such as airfield runways, bridges, factories and bunkers. It can also be used to attack 10,000 ton class ships.

Fig. 3. The X29TE uses the same television camera as the X59M

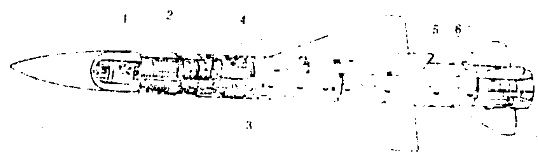


The two models of the X29 missile are the same dimensions, 3.9 meters long, 0.4 meters in diameter, and with a wingspan of 1.1 meters. The X29L and the X29TE weigh 660 and 690 kilograms respectively. The payload for both is 320 kilograms. The X29

missile uses solid fuel propellant. The capabilities are different for the two models. The X29L can be fired between at altitudes of between 200 and 5000 meters and has a range of two to ten kilometers. The X29TE can be fired at altitudes of between 200 and 10,000 meters and has a range of three to 20 or 30 kilometers.

The X58E and X59M missiles

Fig. 4. Diagram of the X58E



1. Missile head. 2. Autopilot. 3. Power source. 4. Warhead. 5. Engine. 6. Servo operator.

These two missiles are both used on the SU-24 fighter bomber.

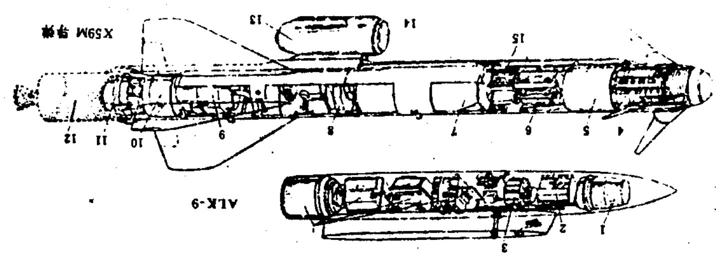
The NATO designation for the X58E is the AS-11 Kilter. It is used to attack air defense radars operating on the A, B and C bands between 0.1 and 1.0 gigaHertz. They are very similar to the French Matela Corporation's Mater (phonetic) and Ahate (phonetic) anti-radar missiles. This missile is 4.8 meters long, 0.38 meters in diameter, has a wingspan of 1.17 meters long and weighs 650 kilotons, including a 149 kilogram warhead. It has a range of 100 kilometers.

The X58E uses a solid fuel engine (two stage) and an automatic pilot on the missile controls the missile, ensuring the direction of the missile flight. After the missile is launched, a passive electromagnetic automatic tracker controls the missile's search for the target radar radiation source. The missile has an 30 percent

hit rate when probability of error is 20 meters of target.

This missile comes in two models. One is currently in service and is being batch produced. The other is an extended range modified model. The X58E is the model is service. The aircraft launch altitude is between 10 and 10,000 meters. The launch flight speed is between 150 and 500 meters per second. The missile has a range of between 36 and 120 kilometers. The improved version has a range of 60 to 250 kilometers.

Fig. 5. Diagrams of the X59M and the ALK-9 target instructions capsule



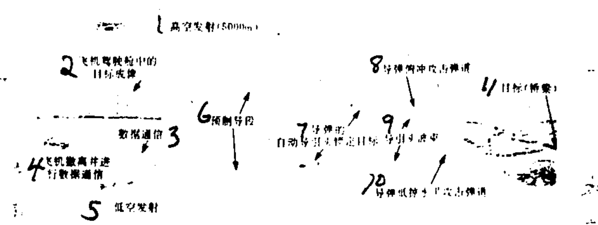
1. Guidance television. 2. Control elements. 3. Recorder. 4. Television guidance head. 5. Control capsule. 6. Radio altimeter. 7. Warhead. 8. Engine control mechanism. 9. Engine. 10. Servo mechanism. 11. Receiver. 12. Booster. 13. Turbojet engine. 14. Air intake. 15. Power source.

The NATO designation for the X59M is the AS-18. It is a type of air-to-surface cruise missile. It is used to destroy small ground and surface targets. The SU-27 can mount two television guided M59M missiles under its wings. Under its fuselage it carries target instruction capsules ALK-9, which is four meters long, 0.45 meters in diameter and weighs 260 kilograms.

The X59M missile is 5.69 meters long, 0.38 meters in diameter, has a wingspan of 1.3 meters and weighs 920 kilograms. The armor

piercing warhead weighs 320 kilograms with 280 kilograms of explosives. Before the missile is launched, the target instructions capsule gets a fix on the location of the target. After the missile is launched the target instructions capsule sends the target data to the missile by radio, exercising initial guidance over the missile until the automatic guidance on the missile captures the target. The missile sends the target image back to the aircraft where it is displayed on the screen. The operator aims at the target controlling the missile using the display on the screen. The missile has an accuracy of within two to three meters.

Fig. 6. Diagram of X59M missile attacking a ground target



1. High altitude launch (5000 meters). 2. Target image in aircraft cockpit. 3. Data signal. 4. Aircraft withdraws and carries out data communications. 5. Low altitude launch. 6. Precontrolled flight section. 7. Automatic guidance head locks on target. 8. Missile makes diving attack. 9. Guidance head waveband. 10. Missile makes horizontal attack at low level. 11. Target (bridge).

The AS18 is an air-to-surface missile, an advanced version of the AS-13. It uses a turbojet engine. The missile is controlled by spoilers on the fixed wings and by four small retractable wings. This missile can be launched at altitudes between 100 and 5000 meters. It flies at an altitude of seven meters and at a velocity of 240 to 280 meters per second. Its range varies with its operational mode. With automatic guidance it has a maximum range of 40 kilometers. When a preset program type (data transmission

remote control) is used it has a maximum range of 115 kilometers.

The R-73 missile

This new air-to-air missile has been given the NATO designation AA-11 Archer. It can be used to equip the Mig-21, Mig-23. Mig-23, Mig-29, SU-27, SU-33, SU-35 and the YAK-141 fighters.

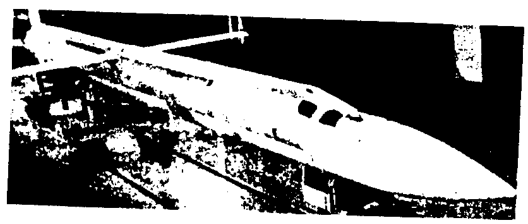
Fig. 7. The R-73 missile exhaust gas deflection equipment

It is claimed that the R-73 is an advanced model of the R-60. The R-73 missile is comparable to the French Matela Corporations's Magic-2 missile. It is a type of missile which can be used for aerial combat or intermediate range intercept. The missile is 2.9 meters long, has a diameter of 0.17 meters, a wingspan of 0.5 meters and weighs 103 kilograms, with a warhead of eight kilograms. It uses a passive infrared searcher. In order to improve the maneuverability of the missile, it also uses exhaust gas deflection equipment to control the direction of the missile.

The R-73 is capable of all-weather, all direction attack. Its minimum intercept range is 300 meters, and maximum range is 30 kilometers. It can reach altitudes of up to 20,000 meters. This missile exhaust gas deflection equipment makes it more maneuverable than other current missiles. It can intercept targets exceeding 12g.

Also, the Russians also exhibited a number of totally new missiles of the NOVATOR Experimental Missile Institute. These included an anti-submarine torpedo missile launched underwater, from a ship or from a vehicle. This missile is 8.166 meters long, 0.533 meters in diameter, weighs 2445 kilograms and has a warhead which is a 742 kilogram torpedo.

Fig. 8. Russian NOVATOR Institute anti-submarine missile

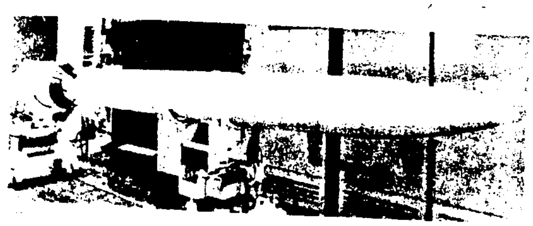


Another missile was the coastal defense anti-ship missile. This missile is launched from a launch container on a truck. Each truck is outfitted with six missiles. The missiles are launched at five second intervals. This type of missile is 8.5 meters long, weighs two tons (not including the launch container). The warhead weighs 200 kilograms. Range is 200 kilometers. The missile uses passive radar guidance. It can attack destroyers and escorts 70 kilometers away. In the final stage of ballistics, the velocity is increased to 700 meters per second. Its cruise speed is only 200 to 240 meters per second.

There was also a type of all direction long range air-to-air missile (AAM-L) which is used to equip the SU-27 and the SU-35 fighters. uses solid fuel propellant, and can also be equipped with an booster engine. The aerodynamic configuration includes four fixed wings and four tail fins. This missile weighs 750 kilograms and has a range of up to 400 kilometers. It can intercept supersonic targets at altitudes of from three to 30,000

meters at speeds of up to 1110 meters per second at perpendicular speeds of 120 meters per second. It is an advanced model of the Amos AA9 which is used to equip the Mig-31. It will be placed in service in the year 2000.

Fig. 9. Russian NOVATOR Institute long range air-to-air missile AAM-L



STATUS OF DEVELOPMENT OF ANTI TACTICAL BALLISTIC MISSILES

BY: Ying Hui

The continuing proliferation of ballistic missiles has created a tremendous threat the security of all nations. The development of anti ballistic missiles, defense tactics or battle zone ballistic missiles are becoming more and more important, especially after the Gulf War, and many countries have already begun consideration of this problem.

Of the surface-to-air missile systems currently in service, there are three types which can handle ordinary ballistic missile threats. These are the Russian S-300 (Nato designation of SA-10/SA-N-6), S-300V1/2 (Nato Designation of SA-12A) and the United States MIM-104 Patriot.

The Russian S-300 was developed in the seventies. It comes in a ground based model (SA-10) and a ship carried model (SA-N-6). The first ground based system was fixed. In 1980 it began to be placed in service. The NATO designation was the SA-10A. The second ground based system was mobile. The NATO designation was SA-10B. It began to be placed in service in 1985. The ship carried system was mounted on rotating vertical launch equipment on Ushakov and Slava class cruisers. This missile is 7.1 meters long, weighs 1500 kilogram and its different models have ranges of 45, 75 and 90 kilometers respectively.

A fourth model with a range of 150 kilometers is under development. The warhead of this S-300 weighs 130 kilogram. It is a high explosive warhead, and can also be equipped with nuclear explosives. This missile uses command and mid-stage inertia

guidance. It also has a semi-active radar terminal guidance head. The missile has a maximum speed of 2600 meters per second. The S-300 system comes with a three dimensional phase-control array combat radar. It can be installed on a 15 meter tower or on a wheeled vehicle.

The S-300 has attack close range ballistic guidance capabilities similar to those of the MIM-104 Patriot. However, it is currently the only ship carried system with anti ballistic missile capabilities. Bulgaria, Czechoslovakia, and Syria have all purchased this weapon.

The S-300V was developed in the mid-seventies. There are two models of this missile. These are the 9A83 (SA-12A) and the 9A82 (SA-12B). The smaller 9A83 began to be placed in service between 1982 and 1986. The larger 9A82 began to be placed in service from about 1990 to 1991.

The SA-12A missile is eight meters long and weighs 1270 kilograms. It has a range of from seven to 25 kilometers. It is used to attack ballistic missiles. Its maximum speed is 1700 meters per second. The SA-12B missile is ten meters long and weights 2050 kilograms. It has a range of between 13 and 40 kilometers. Its maximum speed is 2400 meters per second. Both of these two models use a common 6.4 meter long second stage. The second stage includes the guidance equipment, fuse and warhead. The warhead is filled with 150 kilograms of high explosives, and may also be nuclear explosives.

The SA-12B missile uses intermediate inertia guidance with command correction and semi-automatic radar terminal guidance head with missile tracking. It is stated that an active radar terminal guidance head is currently being developed for this missile.

The S-300V system has four radars: a 9S15MT long range surveillance radar with an operational range of up to 250 kilometers is mounted on a tracked vehicle; a 9S19 fan shaped sweep radar is used to handle ballistic missiles; a 9S32 combat radar and a target irradiating radar. The two models of the S-300V are both installed in sealed containers. When launched, they are raised to a vertical position. The missile and radar vehicles are Telar 9A83 or 9A82 trucks.

The S-300V system uses a fairly large impact shrapnel warhead. Furthermore, they fly fairly fast, and have better properties than the MIM-104 Patriot.

The Russians have used the S-300V to intercept SS-4 and SS-12 missiles in tests. However, the Russians are aware that this type of missile does not have the capability of attacking strategic ballistic missiles.

Development of the MIM-104 Patriot missile began in 1967. It was placed into use in 1984. The Patriot missile is 5.2 meters long, weights 914 kilograms and has a range of 70 kilometers. This missile has a maximum speed of 1500 meters per second. Its shrapnel warhead weighs 90 kilograms. It uses intermediate stage inertia guidance with command correction and missile tracking semi-active radar terminal guidance head. A PAC-3 modification plan is currently being carried out in preparation for developing an active radar terminal guidance head for this missile. The Patriot system uses a multiple function three dimensional phase controlled array radar. It is both a surveillance radar and an acquisition radar. Germany and Israel have purchased this missile.

Compared to the Russian S-300 and S-300V, the Patriot is smaller, lighter, and possibly less expensive.

In attacking tactical missiles, these three missiles are all about the same, but the Patriot launch speed is slower, and it is lighter, and may have better guidance than the S-300 and S-300V. Also, the S-300 and S-300V systems' SA-12B fly faster, which is better for intercepting high speed incoming missiles.

Some research indicates that surface-to-air missiles may not be capable of successfully intercepting and destroying advanced tactical missiles. What will be required in the future are directed energy weapons systems, such as aircraft carried or land based or ship based laser weapons. At the present time a number of countries such as France, Germany, Russia and the United States have already made some progress in small, high power laser weapons research.

A third type of anti tactical missile weapon has already appeared. This is the hyper velocity gun. Because the projectile travels at high speeds (3000 meters per second) and is light weight, and is inexpensive, it can be fired continuously at any target. This is extremely attractive for tactical missile defense.

Post firing flight of S-300 misslie. This missile has anti-missile capabilitie similar to the Patriot

Anti-tactical missile systems

SYSTEM	NATIONS POSSESSING SYSTEM
SA-10 (S-300 Buk)	Russia, Belorus, Bulgaria, Czech, Slovakia, Syria Ukraine
SA-12A (S-300V/2)	Russia
SA-12B (S-300V/1)	Russia
SA-N-6 (S-300 Rif)	Russia, Ukraine
MIM-104 Patriot	U.S., Germany, Israel, Italy, Japan, Kuwait, Netherlands, Saudi Arabia, Turkey

MISSILE SYSTEM	NATIONS POSSESSING SYSTEM
ATBM model	France and Italy
Asite (phonetic)	
LATEX (laser weapon)	France
HELEX (laser weapon)	France
Akash	India
FAW-1	Iraq
SAM systems	Iran
AB-10 SAM	Israel
Rocket/ACES	Israel
Hyper velocity guns	Israel
Short range SAM-2	Japan
Hyper velocity guns	Japan
Anza SAM	Pakistan
SA-X(?)	Russia
Ground-based laser weapons	Russia
Airborne laser weapons	Russia
Hyper velocity guns	Russia
Tiangong (phonetic)-3	Taiwan
RIM-67 (LEAP)	United States
ERIMT	United States
THAAD	United States
ASAM-1	United States
Army class SAM	United States
Ground based lasers	United States
Airborne lasers	United States
Hyper velocity guns	United States